

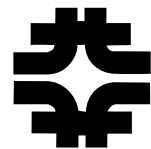
Technical Division

Bob Kephart

Fermilab

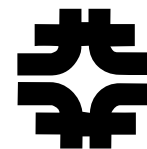
March 29, 2005

I will discuss only about 25% of what the Technical Division does



- Operations Review:
 - Maintenance and operation of the accelerator complex in support of the HEP research program.
 - Improvements to accelerator performance via upgrades to meet expanded physics goals.
- Program Review
 - R&D in accelerator technologies aimed at next generation HEP facilities and beyond.
 - Construction of new accelerator facilities
 - Support of Projects (LHC, Auger, etc)

Mission Statement



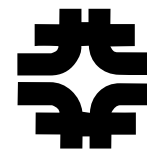
- The Technical Division is responsible for the development, design, fabrication or procurement, and testing of accelerator and detector components.
- The Technical Division provides labor, expertise, and facilities for a variety of activities related to this mission.
- Growing role in Accelerator R&D

TD Supports Accelerator Operations



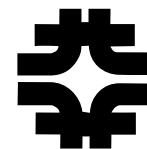
- Provide support for FNAL accelerator complex
 - Build accelerator magnets and components
 - Repair conventional and SC magnets (1.1.1.9)
 - Design/build new magnets and devices
 - Magnets for Accelerator Maintenance & Operations (1.1.1.1-5)
 - Magnets for Accelerator Upgrades (1.1.2)
 - e.g. Electrostatic Separators or Booster Orbump Magnets as part of R2LU (1.1.2.3)
 - e.g. MI Wide aperture quads as part of Proton Plan (1.1.2.1)
 - Perform magnetic measurements
 - Operate Magnet Test Facility (MTF) (1.10.5.2.1)
 - Design/build magnetic measurement equipment (1.10.5.2.2)
 - Measure SC & conventional magnets (1.1.1.12 and 1.1.1.13)
 - Maintain database of magnetic measurements (1.10.5.2.5)

TD Supports Accelerator Operations



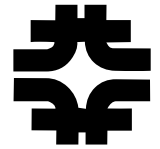
- TD provides expert workers to AD
 - Experienced workers for Accelerator shutdowns
 - Experts for “in tunnel” repair or modification of magnets and other components as required
 - Rapid response for locating and moving magnets or other components in TD spares inventory as required for emergency accelerator repairs

TD Supports Accelerator Operations



- Work with AD on long range technical issues
 - Measure TeV dipole magnets to understand persistent current phenomenon (tune drifts, 150 GeV lifetime & losses) as part of R2LU (1.1.2.3)
 - Electron Cooling installation (1.1.1.4)
 - Build/test new instrumentation e.g. flying wire (1.1.2.3.3)
 - Tasks for Accelerator Division evolve with time
 - Issues are resolved or become irrelevant
 - Operational experience often leads to new tasks being added
 - We manage & set priorities
 - Annually to set the approximate “Level of Effort”
 - Bi-weekly by reviewing/modifying a task list in a TD/AD meeting

TD/AD Resource Management



- TD and AD work together to establish a TD “Level of Effort” on AD tasks each year as part of the FNAL Division Budget Reviews
- Resource needs are estimated via a TD/AD job list. (includes repair of devices, new devices (R2LU, Proton Plan, others), & studies to be performed)
- Support for Accelerator Operations is given our highest priority → With AD we establish the priority of tasks, identify the required M&S and SWF to carry out the tasks, then assign the required TD resources to insure the tasks are completed on schedule
- This is a dynamic process... the list is updated often

TD/AD Job List

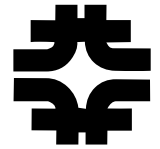


Accelerator Division Tasks as of 17 February 2005

Priority	Status	System	Job No.	Task Name	Scope of Work	TD Contact	AD Contact	Units Req'd	Units Comp	Project	Task	TD Comment	DRAFT TD Schedule
1	0	B	203	OrBump replacements	Design, procure and assemble OrBump replacements.	Makarov	J Lackey	6	0	32	EF 1.02.02.01 M+S 1.02.02.01	2/15/2005 Magnetic measurements will continue at MTF. The power strip is to be redesigned to change its basic layout. The girder design is being reviewed.	Complete in May 2005
1	0	B	291	Booster trim package R&D	Fabricate replacements for activated Booster trim packages, perhaps with greater capability. Production to be performed on job #382. (includes job 292)	Harding	J Lackey			32	DT 1.02.03.01 EF 1.02.03.01 MC 1.02.03.01 M+S 1.02.03.01	2/15/05 The mechanical design continues using solid copper and cooling tubes integrated into the coils.	Schedule under development
1	0	B	364	Replacement Booster kicker magnets	Build 10 Booster kicker magnets plus spares with square aperture ceramic beam tubes	Chester Makarov	Lackey	14		30	DT 30.9.1.1.1.8.1 EF 30.9.1.1.1.8.2 MC 30.9.1.1.1.8.3 M+S 30.9.1.1.1.8.9	2/15/05 Design for a rectangular tube has been released for procurement. An order for (30) bare tubes will be placed with the desired end result of (10) complete (brazed) beam tubes plus spares. The ferrite brick design is being updated to reflect tighter tolerancing. Negotiations with the brick vendor suggests this should be no problem, and could hold the previous price.	
1	0	FMI	274	New coils for LEP horizontal correctors	Fabricate replacement coils for the LEP corrector dipoles MCH. Deliver (4) for fall 2004 shutdown. See also job 351.	Makarov	C Gattuso	33	11	30	EF 30.9.1.1.2.2.2 MC 30.9.1.1.2.2.3 M+S 30.9.1.1.2.2.9	2/15/05 Finished coils are being assembled into old magnet iron.	Balance complete 4/2005
1	0	FMI	295	WQB Larger aperture quads	Design and build wider aperture quads for extraction regions to replace IQB's	Carson	I Kourbanis	9	0	32	EF 1.03.01.01 MC 1.03.01.01 M+S 1.03.01.01	2/15/05 Winding of the main coil has begun. Curing tooling is expected next week. Stacking tooling was returned to vendor for corrections. We expect to assemble the first magnet without a beam tube for testing. Afterward the magnet will be ground apart and reassembled with the beam tube. A brief retest will be performed. Core stacking on subsequent magnets will be delayed pending the first week of testing. (7) magnets are to be completed and tested by 9/21/05.	First mag to MTF 5/05, seventh magnet Sep 2005, spares in FY06
1	0	FMI	351	New coils for LEP verticle correctors	Fabricate replacement coils for the LEP corrector dipoles MCV. Deliver (9) for fall 2004 shutdown. See also job 274.	Makarov	C Gattuso	58	10	30	EF 30.9.1.1.2.2.2 MC 30.9.1.1.2.2.3 M+S 30.9.1.1.2.2.9	2/15/05 Finished coils are being assembled into old magnet iron.	Balance complete 4/2005
1	0	L	285	Linac Amplifier Tube	Prepare mechanical drawings of existing tubes in FY04	Chester	Czarapata			36	EF 2.01.01.02.01 MC 2.01.01.02.01 M+S 2.01.01.02.01	1/19/05 Design is in process. An AD visit to the vendor hopes to negotiate terms to rebuild existing units plus manufacture (12) new units at a rate of (6) per year. The IFermilab task force is going to recommend a longer range strategy in a report due by early summer.	
1	1	Pb	204	AP2 debuncher aperture restriction	Evaluate AP2 transfer hall to determine any obvious aperture restrictions.	Chester	K Gollwitzer	na	0	36	EF 1.02.02.01 MC 1.02.02.01 M+S 1.02.02.01	1/7/04 Tables done except need kicker and stochastic cooling inside dimensions. AP2 drawings complete. Debuncher drawings still to be done.	
1	1	Pb	225	New Debuncher extraction kicker	Orig Plan: Design and fabricate a new, larger aperture, Debuncher extraction kicker. Updated Plan: Replace ceramic tube in existing kicker.	Chester	K Gollwitzer			36	EF 1.02.02.05.02.04 MC 1.02.02.05.02.04 M+S 1.02.02.05.02.04	1/19/05 Discussions have concluded modifications to the existing ferrite core is not desirable. New design and construction could provide completed magnets by the 2006 shutdown. The goal is a decision in February.	

- Just a part of more than 60 jobs on the current list... evolves with time

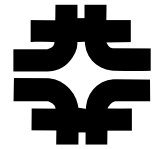
Indirect Support



- TD also Provides Lab-wide services
 - Machine Shop Department (1.10.9)
 - Machinists & welders → chargeback system
 - E.g. machining of radioactive materials, welding in the tunnel
 - Materials Development & Test Lab (MDTL)
 - (1.13.1.2.4 + effort reported to specific projects)
 - Provide materials expertise & test capabilities
 - Material Control Department
 - (1.13.1.2.4 + effort reported to specific projects)
 - Provide specialized procurement capabilities & vendor liaison
 - Make/buy advice for FNAL machine shop work
 - Inspection & QC capabilities
 - Inventory control of magnets and special materials
- All contribute to Accelerator Operations

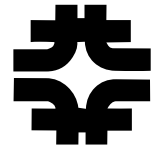
Other Programs & Responsibilities

(will be covered in the DOE Annual Review)



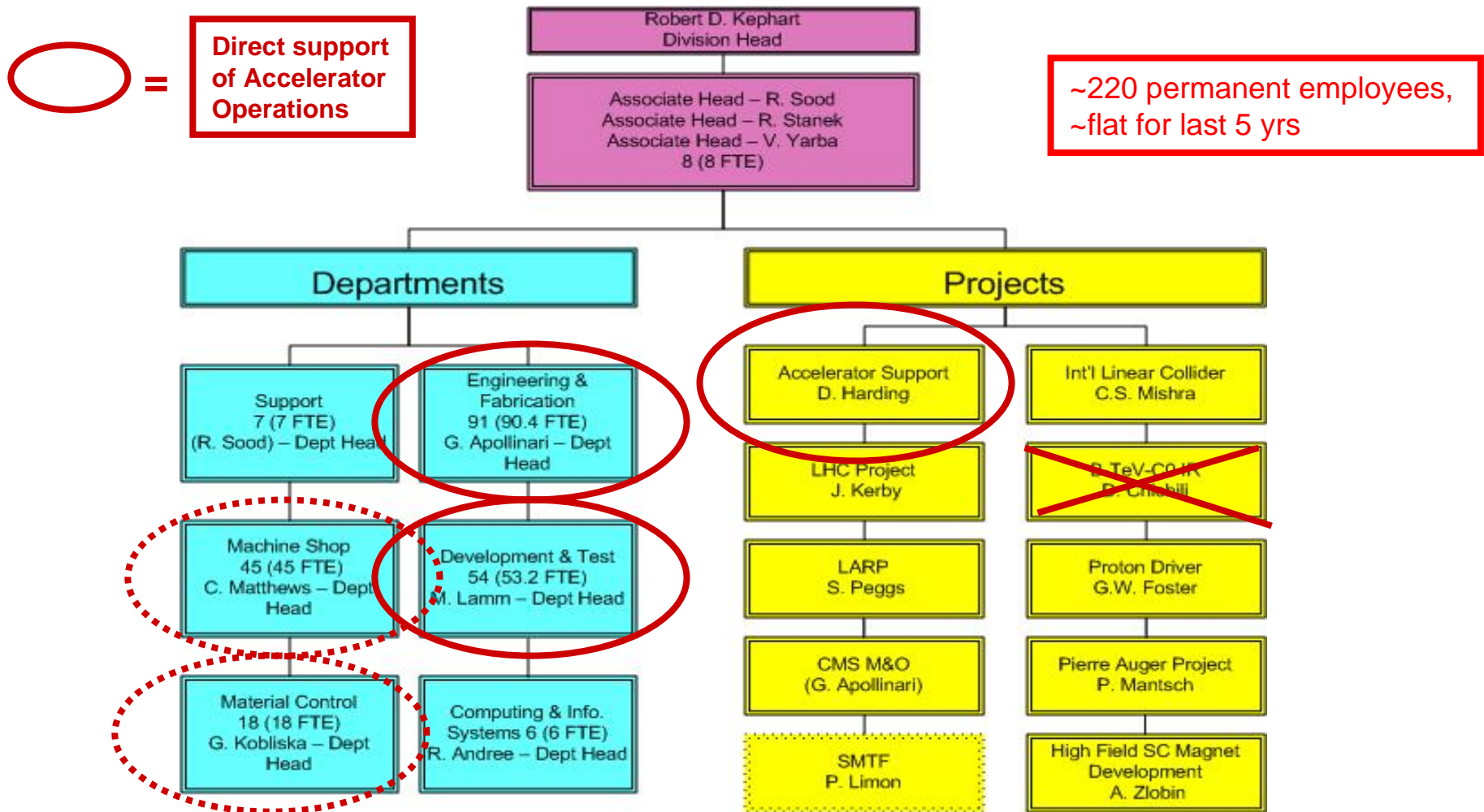
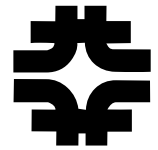
- Accelerator R&D activities:
 - SC magnets for future accelerators:
 - SC Materials research (1.7.1.3)
 - High-field magnet development (1.7.1.4)
 - Linear Collider R&D (1.7.4)
 - Proton Driver R&D (1.7.7)
 - Superconducting RF Infrastructure (SMTF) (1.7.8)
 - US LHC Accelerator Project (Program Office) (1.3.1.1.1)
 - Multi-lab collaboration (FNAL, BNL, LBNL, KEK)
 - US LHC:FNAL (IR Quad fabrication) (1.3.1.1.2)
 - US LHC Accel. Research Program (1.3.4)
 - e.g. 2nd generation Nb₃Sn quads for LHC
- Other
 - Pierre Auger (Project Office & eng. / design) (1.9.3)

Technical Division Organization

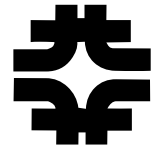


- Matrix management
 - Labor and physical resources are managed by Department Heads.
 - Every person has a “home” in a department
 - Facilities, labs, infrastructure are maintained independent of active projects
 - Large projects or activities have a dedicated management team but obtain the bulk of their resources from the Departments.

Technical Division Organization



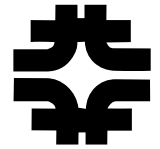
Technical Division Personnel



	FY 2000	FY 2001	FY 2002	FY 2003	FY2004	FY2005	
Scientist	18.6	20.6	20.6	22	23	23	← Accel R&D
Engineer	24	27	31	35	36.8	39.6	
Engineering Physicist	7	6	7	7	7	7	
Computer Professional	10.2	9.2	9.2	10.2	10.2	10.2	
Designer Drafter	14.6	14.6	14.6	11.6	11.6	12.8	
Technician	71.4	70.8	68.2	67.1	71	70	
Machinist	45	45	44	40	36	32	← Machinist + welders are down
Welder	13	15	11	10	10	10	
Administrative	15.6	14.6	15	9	10	10	
ES&H/QA/budget				6.2	6	5	
Leave of absence				2	0	2	
TOTAL Permanent	219.4	222.8	220.6	220.1	221.6	221.6	
Term Technician	0	6	11	14	5	5	← Load Leveling
Guest Scientist/Engineer	10	16	11	4	3	1	
Open Requisitions	2	9	4	1	3	8.2	← 2 hires/ rest closed FY06 guidance
Total	231.4	253.8	246.6	239.1	232.6	235.8	
Contract worker	25	24	11	8.9	1	4	← Load Leveling
Grand Total	256.4	277.8	257.6	248	233.6	239.8	

No significant change in the size of TD permanent Staff in last 5 yrs
 Admin staff is lean. Shift from Machinist/welders to Engineers/physicists

Establishing the TD Budget



- We use a bottoms up approach each fiscal year
- Directorate establishes the overall goals...
- TD Identifies the required staffing levels to meet goals
 - Assign present staff consistent with these goals
 - Identify labor shortfalls
 - Identify the required SWF to support this labor force
 - Identify SWF income from projects funded outside TD base budget
 - Estimate the SWF burden on the TD base budget
- Then estimate the required M&S to support R&D, operations, and projects supported by the base budget
 - Compare this with our budget guidance
 - Iterate and adjust as required
- Support for the Accelerator Complex has #1 Priority

TD Labor Plan - FY05



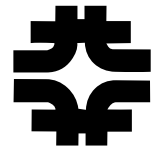
	CMS/M&O	LHC	LHC (off project)	ILC	SCRF	Proton Driver	HFM	LARP	BTeV	BTeV (off project - R&D)	BTeV (off project - physicists)	Auger	JDEM/DES	Phys Research	Proton Plan + Accel Upgrades	Accel M&O	R2LU	MTF M&O	MTF Upgrades	Admin	Infrastructure (Facilities+GIS+Dept Mgmt)	Division Mgmt	ES&H	Machine Shop + Unassigned	Total	Total FTE on Outside Projects
Scientist	0.80	0.00	0.81	1.75	1.10	1.60	2.80	0.53	0.00	0.00	0.89	2.10	0.40	0.95	0.30	0.30	1.56	1.51	0.90	0.00	2.80	1.90	0.00	0.00	23.00	1.33
Guest Sci/Post Doc	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
Engineer	0.00	2.24	0.17	9.73	0.95	5.60	6.05	1.18	0.00	2.16	0.00	1.00	0.00	0.00	0.88	1.65	0.93	1.85	1.92	0.00	2.29	1.00	0.00	0.00	39.60	3.42
Guest Engineer	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Engineering Phys	0.00	0.10	0.42	0.40	0.00	0.85	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	1.51	1.67	0.00	0.70	0.50	0.30	0.00	7.00	0.10
Comp Professional	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.20	1.70	0.00	6.10	0.00	0.00	0.00	10.20	0.00
Drafter	0.00	0.20	0.00	3.34	0.47	2.00	1.84	0.60	0.00	2.14	0.00	0.00	0.00	0.00	1.00	0.34	0.40	0.00	0.20	0.00	0.27	0.00	0.00	0.00	12.80	0.80
Staff Technician	0.00	1.87	0.00	1.75	0.45	0.25	2.10	0.48	0.00	0.00	0.00	0.10	0.00	0.00	1.02	1.33	1.47	0.92	1.83	0.00	4.93	0.00	0.50	0.00	19.00	2.35
Technician	0.00	8.93	0.00	2.47	1.07	0.40	4.10	0.30	0.00	0.10	0.00	0.60	0.00	0.00	5.75	7.80	4.90	3.95	1.95	0.00	7.98	0.00	0.70	0.00	51.00	9.23
Term Technician	0.00	3.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.00	1.00	5.00	3.60
Administrative	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	0.00	0.00	0.00	1.00	10.00	0.00
ES&H/QA/Budget	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.25	0.25	0.00	0.00	0.00	1.20	0.00	3.00	0.00	5.00	0.00
Contract	0.00	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.20	0.00	0.00	0.00	1.00	0.00	0.00	0.00	4.00	0.80
Leave of Absence	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00	0.00
Machinists	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.00	32.00	0.00
Welders	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	10.00	0.00
Posted Openings			0.45	1.75		0.75	0.85			0.00	0.00	0.75			0.35	0.95			0.40		1.95				8.20	
Total FTE	0.8	17.7	1.9	21.4	4.0	11.5	18.4	3.1	0.0	4.4	0.9	5.6	0.4	2.0	9.4	12.7	11.7	11.9	10.6	8.0	29.6	3.4	4.5	46.0	239.8	25.2
Total Salary \$	117	1291	230	2356	441	1370	2044	336	0	460	118	633	76	193	777	1042	907	1143	1038	437	2848	625	446	51	18981	2087

In FY05 ~46 FTE work on direct support of the Accelerator Complex (SWF = \$ 3869 K)

TD also works on Projects like LHC, Auger, and on Accelerator R&D: HFM/LARP, ILC, and Proton Driver

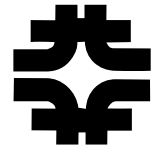
* Machine Shop and Material Control personnel contribute indirectly to Accel Operations: e.g. radioactive machining work, specialized procurement, upgrades to MTF are largely in support of Accel R&D.

Projections FY06-FY09



- Tevatron Operations will end in ~FY09
- Tevatron magnet testing in MTF will roll off
 - Facility will still be used for High Field Magnet Program, LARP, and perhaps SC magnets for ILC (quad/final focus)
 - We envision part of MTF will transition to SCRF testing
 - Vertical and Horizontal Test of single cavities
 - SCRF module testing for PD and ILC
- Testing of Conventional Magnets in MTF will continue (MI, booster, beam lines will still be operational)
 - Expect a reduced level of effort on this as upgrades associated with R2LU and Proton plan wind down
 - Increased effort for Proton Driver (e.g. transfer lines) ?

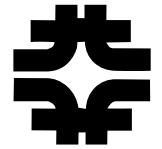
Lab Wide WBS FY04-09



<u>Laboratory WBS Structure Total</u>									
Summary Level (all) (All)									
<u>Division/Section</u> <u>DS - Technical Division</u>				<u>FY04 Actual</u> <u>Base</u>	<u>FY05 Actual</u> <u>Budget</u>	<u>FY06 PBR</u>	<u>FY07 FLAT</u> <u>TO PBR</u>	<u>FY08 FLAT</u>	<u>FY09 FLAT</u>
1.1	<u>Accelerators</u>			4,630.0	5,724.0	4,954.0	4,553.0	4,737.4	4,955.3
1.1.1	Accelerator Maintenance and Operations			2,523.2	1,407.0	2,431.0	2,243.0	2,331.7	2,435.6
1.1.2	Accelerator Upgrades			2,106.8	4,317.0	2,523.0	2,310.0	2,405.7	2,519.7

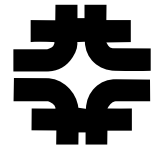
- Funding to Support the Technical Division's "direct" work on the Accelerator Complex is contained within WBS elements shown above
- Indirect part (e.g. Machine shops, Div Management, etc) and part of the support for MTF is in Programatic Support (1.10.5)
- Overall funding is relatively flat except for bump in FY05/06 associated with the R2LU and Proton Plan upgrades
- Our MTF plan doesn't yet fully reflect demise of BTeV and the end of Tevatron operations. The expectation is that Tevatron magnet testing will roll off as effort shifts to SCRF in support of ILC and Proton Driver.

Magnet Inventory



- Technical Division manages the inventory of spare magnets (except the ones too big for its facilities)
- Magnets are tracked in a database accessible over the Web (OnBase)
- Spares are included in the plan for new projects (but paid for from operating funds)
- Spares status is periodically reviewed
- A magnet failure also triggers a review and, if needed, a repair

Risks & Mitigation



- Accelerator support is funded as a “level of effort”
 - Major accelerator equipment failures, unplanned shutdowns or performance problems → increased labor or M&S needs
 - Mitigation is that both TD and AD report to the same Associate Director (Steve Holmes) We work together to insure that resources are allocated appropriately
- Magnet spares inventory
 - How do we know we have adequate spares ?
 - Mitigation: Frequent review of spares situation, trends in device failures, etc. followed by discussion at TD/AD biweekly meeting. Repair tasks are adjusted in priority to assure adequate operational spares for critical devices
- TD is the repository of key knowledge for some critical Accelerator Devices
 - Risk = loss of expert personnel (e. g. magnet experts)
 - This is a concern, but we do inject young people into the system (e. g. P Bauer, G Veleev, S Makarov, etc.)

Risks & Mitigation



- Aging workforce in some key technical areas
 - MTF cryogenic operators: A couple new people involved
 - Conventional magnet construction: A junior engineer was added
 - Machinists: Conscious decision to reduce workforce
- Overall: TD workforce distribution is reasonable (04 DOE ops review)
- Facilities and equipment
 - Building maintenance issues:
 - Limited GPP money for refurbishment of existing bldgs, & replacement of poor Village buildings is a problem
 - Electrical feeder maintenance in TD
 - Modernize machine shop and its equipment
 - Long standing problems that have been difficult to address given Lab's budget and priorities

Conclusions



- The Technical Division provides a unique blend of industrial expertise and R&D capabilities in support of Accelerator Operations
- We spend considerable effort each year to evaluate the necessary labor force and M&S for this support
- We work closely with Accelerator Division and the Directorate to establish priorities and distribute the available TD resources in the most effective way